Automatic take-off control system

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Abstract:

Today's aircrafts are highly automated machines. Diverse stabilization and control systems take over more and more tasks, previously performed purely by pilots. These systems are being implemented especially in the control areas, in which the human abilities of perception and correct decision making are found to be insufficient. Avionic solutions are already taking over many pilot's duties such as managing a stable flight on the desired path or carrying out a smooth touchdown. However, even UAVs demand the active presence of the flight operator, who schedules the approach, performs take-off and taxiing. The indispensable factor in achieving complete flight automation is to supplement control systems in these flight areas, which are still fully human–dependent. The most important of them is the take-off phase.

The algorithms providing the automatic take-off manoeuvres will be discussed within this project. They complement other flight control systems. In the development of the algorithms, the following design principles were adopted:

- The automatic take-off system begins its operation when the aircraft is preconfigured for flight and positioned on the active runway.
- The aircraft brakes are released.
- The system does not provide control of the flaps.
- The system provides aircraft control unit up to 50 ft. after lift-off.
- The aircraft is equipped with a measuring system that provides information about forces exerted on the landing gear wheels.
- The aircraft is equipped with INS and EGNOS systems.
- The aircraft is equipped with an on-board camera that records the view of the runway.

An aircraft will be controlled by two autopilot channels: longitudinal and lateral, with appropriate control surfaces: ailerons, elevator, rudder as well as engine thrust. Additionally, the system counts the landing gear's contact force. The considered solution takes into account take-off as a manoeuvre made of three phases: start roll, take-off roll, and lift-off roll & transition. The aircraft control on a runway is possible due to the data fusion from the INS and GNSS systems. The data fusion may be supported by using the runway image processing system.

The proposed take-off control algorithm completes existing autopilot systems and creates a coherent control environment. An automatic take-off process will enable pilots to focus on other tasks while managing the flight. It is particularly relevant in adverse weather conditions or during military operations, in which the pilot has to man multiple on–board combat systems. For applications in unmanned aerial vehicles, automation reduces the duration of the manoeuvre and adjusts it to the aircraft's structural capabilities. This system solves the problem with controlling multiple units at the same time. The development of unmanned aerial vehicles (UAVs) could especially revolutionize the way that air forces will be used in the future. While the performance of earlier operations with the use of autonomous aircraft showed great promise, their full capabilities are largely unknown. However, it is clear these technologies will enable air forces to use their power more efficiently and that means lower operational costs and lower risk for the human pilot.